AD-A042 972 OFFICE OF NAVAL RESEARCH LONDON (ENGLAND) F/G 5/2
EUROPEAN SCIENTIFIC NOTES NUMBER 7-23,(U)
DEC 53 J R REITZ, E EPREMIAN
UNCLASSIFIED ESN-7-23 NL

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OFFICE OF NAVAL RESEARCH

LONDON

(6) EUROPEAN SCIENTIFIC NOTES

Number Nos. 7 - 23,

(11) 1 December 1953

(12) 15p. (14) ESN-7-23

Distributed by the Office of Naval Research
Washington 25, D. C.

(10) J. R. Reitz
E. Epremian

P302

AMERICAN EMBASSY LONDON, ENGLAND

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OFFICE OF NAVAL RESEARCH
London

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TECHNIQUE FOR THE MEASUREMENT OF HEAVY PRIMARIES IN THE COSMIC RADIATION

Dr. B. Waldeskog of the University of Lund, Sweden, has been applying the technique of the photoelectric measurement of track density developed by Professor Sten von Friesen to the determination of the charge Z of heavy primaries in the cosmic radiation. The photoelectric apparatus and its use have been described (K. Kristiansson, Phil. Mag. 44, 269 (1953)). It consists essentially of a microscope in which the image is focussed through a slit onto a 1P21 photomultiplier whose output goes through a linear cathode follower to a speedomax recorder. Using this outfit the track density can be determined, and since the variation of track density with residual range is characteristic of the charge, the charge can be determined. The apparent track density will vary with depth in a thick emulsion because of difference of development and because of the scattering of light by other tracks in the emulsion.

Waldeskog has used fast relativistic particles traversing the emulsion to determine the characteristic density curve for that emulsion. The result is independent of the angle of dip of the track as long as its tangent is less than 0.4. In this way he can determine the characteristic curve for a

particular emulsion in about an hour. He has investigated the optimum slit width (projected back to the emulsion) for particles of different charges and finds a variation from the standard 2 μ for singly charged particles up to 20 μ for Z = 14. Delta rays which extend beyond these widths make no significant contribution to the track "area". His results so far, if one plots the number of tracks vs. the log of the track "area" in a length of 300 μ, show a beautiful resolution into groups up to Z = 14 with absolutely no overlap between the groups. At the present time Waldeskog's work is hampered by a lack of plates with heavy primaries in them. Perhaps other laboratories might have some plates on which this work could be continued. The preliminary results will be published in Arkiv för Fysik.

Mr. Goran Leide, also at Lund, has investigated the fading of G-5 emulsion with time under different conditions of storage. He also used a photoelectric measuring outfit to read his plates which were exposed to protons from the Uppsala cyclotron arranged so that the protons stopped in the emulsion. He then stored his emulsions for 95 days under varied but constant conditions of storage and then re-exposed his emulsion to protons directed in such a way as to be at right angles to the first group. He then compared the density of the two groups of protons in the region from 300 to 630 μ from the end of the tracks and ascribed any difference to fading of the latent image. His conditions of exposure were as follows: 20 per cent humidity and 3°, 20° or 31.4°C; 69 per cent humidity and 3°, 20° or 31.4°C.

Leide found no fading at 20 per cent humidity for any of the temperatures used. At 69 per cent humidity and 3°C there was also no fading, but at 20°C

the fading was 10 per cent and at 31.4°C the fading was 73 per cent. There was no variation of the fading with depth in the 400 μ emulsions. Although there was no fading at 20 per cent humidity there seemed to be some indication of a greater fog due to storage at this humidity. This appeared as the formation of larger grains in the emulsion. It should be pointed out that there may be more fading than that observed here for tracks due to lower ionization which correspond to the formation of a weaker latent image.

THE ADSORPTION OF GASES ON URANIUM OXIDE AND SOME OF ITS MIXED OXIDES

In his Tilden Lecture to the Chemical Society of London on 15 October, Dr. J. S. Anderson (AERE, Harwell) discussed some new results on the adsorption of oxygen and other gases on uranium oxide, UO_2. This work, which was carried out under the supervision of L.E.J. Roberts, provides the first clear-cut example of adsorption on an oxide which can proceed to a significant extent without a nucleation process complicating the picture. The uranium oxide lattice can withstand an appreciable change in composition and oxidizes without structural change. The oxygen is taken up in the form of interstitial anions as shown by the density increase from 10.9 to 11.2 in the course of this process. The oxygen diffuses into the lattice as it reacts, there being no outward diffusion process; thus a surface of constant area and properties is retained. The whole surface is reactive like in a metal, but unlike in a metal, as mentioned above, no new phase is formed.

The quantitative measurements indicate that at least one oxygen molecule is adsorbed per U^{4+} ion. The heat of adsorption is independent of particle

size and is about 25 - 30 Kcal/mole at -183°C; it is thus similar to that obtained for oxygen on other metallic oxides. Following the initial step a slow process is observed: a slow uptake of oxygen amounting to the equivalent of several monolayers. This oxygen penetrates into the lattice, and, since the time dependence is logarithmic, the kinetics of the process is not that of diffusion. In addition it was found to have a very low activation energy. The early stages of the process are identified with the Mott-Cabrera model, according to which the migration is imposed by the existence of high space charge. The process changes over to a true diffusion at about 80°C where the activation energy rises to about 30 Kcal.

Dr. Anderson devoted detailed attention to the mechanism of the striking instantaneous chemisorption of oxygen at -183°C. It was found that this chemisorption also occurs on solid solutions of UO_2 with ThO_2. The cell dimensions of such isomorphous crystals are very similar to pure UO_2 and they oxidize in the same way. The amount of chemisorption on surfaces of such crystals falls linearly with mole per cent ThO_2 proving that the initial oxygen chemisorption is not a two-site process. The thoria acts as a diluent here as it does not chemisorb oxygen under such conditions. The linearity mentioned persists down to about only 10 per cent UO_2. Approximate potential energy diagrams of the various plausible processes lead to the conclusion that in the initial chemisorption O_2^- is formed, in close agreement with the conclusions of the Bristol school regarding the adsorption of oxygen on cuprous oxide (cf. ESN 6, 312 (1952)).

Another solid solution of UO_2, namely that with Y_2O_3, was reported by Dr. Anderson as a useful

substance in the study of vacancy diffusion. Good large crystals of these two oxides (solid solutions) can be obtained by firing at 2200°C and the melting point of the solid solution is estimated at 2600° - 2800°C. It was observed that these crystals are oxidized to completion at room temperature in a few hours, indicating that every anion vacancy gets filled with oxide by a vacancy-diffusion process.

DEFORMATION BANDS AND STRAIN-HARDENING OF ALUMINUM SINGLE CRYSTALS

In an early stage of deformation the crystal lattice can rotate on one side of the bend plane only, resulting in the appearance of a characteristic kink on the crystal surface. At a later stage slip lines from both sides of the band are held up as the dislocations become trapped at the local curvature of the lattice, and the deformation band (or S-shaped kink band) is formed. For some time there has been an active controversy among British investigators of plastic deformation as to whether deformation bands contribute to strain-hardening (cf. ONRL-28-52). One group led by Dr. R.W.K. Honeycombe of Sheffield believes that deformation bands exert considerable influence on the strain-hardening characteristics. Others, however, have maintained that the only effect of a kink band is to decrease the free path for the movement of dislocations and therefore should be about as effective as grain boundaries which are known to be relatively unimportant in strain-hardening.

Honeycombe has recently extended his research on the mechanism of plastic deformation in pure aluminum, particularly with regard to the role played by kink bands in strain hardening. He prepared single crystals of pure aluminum with a square

cross section and of sufficient length that they could be cut up into several pieces, thus providing a number of specimens of the same orientation for tensile test. These tests have been at the temperature of liquid air, room temperature, and 200°C, using a portion of the parent crystal for each temperature. Examination was made microscopically to observe slip marking, by back reflection X-ray diffraction to indicate strain asterism, and by the Barrett low angle X-ray technique to detect regions of high strain. These observations were correlated with the stress-strain curves obtained in tensile test.

The most interesting and illuminating results were obtained with crystals of intermediate orientation (A in the stereographic triangle). As shown in the accompanying figure, the stress-strain curves for room temperature and liquid air temperature cross.

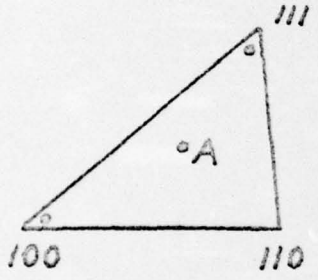

Fig. 1. Orientations of Crystals.

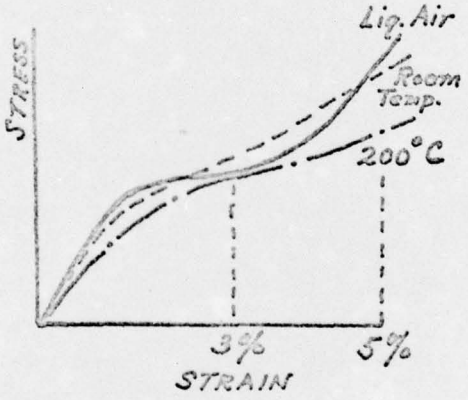

Fig. 2. Stress-Strain Curves for Crystal A.

At 3 per cent strain the specimen pulled at room temperature had a greater degree of strain hardening than that tested at liquid air temperature and from the X-ray and metallographic observations the former showed greater asterism and more kink bands than the latter. These same specimens at 5 per cent strain showed opposite behavior with regard to strain hardening and in this case more asterism and a greater number of kink bands were observed in the specimen tested at liquid air. Thus Honeycombe has shown quite convincingly that kink bands can play an important role in strain hardening.

Other crystal orientations have been studied in a similar manner. For the [100] orientation it is found that an extremely high degree of strain hardening occurs, but in this case the deformation is by multiple slip with no kink bands. In the [111] orientation there is also appr[illegible]ble strain hardening with deformation b[illegible]p as well as kinking.

HUMAN AND COW'S MILK AS SOURCES OF CERTAIN GROWTH FACTORS FOR INTESTINAL LACTOBACILLI

It is well known that lactobacilli constitute an important part of the intestinal flora of man. In breast-fed infants L. bifidus is the main species, whereas L. acidophilus predominates in older children and adults. As breast-fed children are weaned, the L. bifidus vegetation gradually disappears. Since the bifidus flora seems to be closely connected with the well-being of children many attempts have been made to develop artificial food mixtures capable of promoting the maintenance of L. bifidus. Helge Gyllenberg, Marjatta Rossander,

and Paavo Roine of Helsinki, Finland, carried out investigations the main purpose of which was to establish to what extent the nutritional requirements of L. bifidus can be met by human and cow's milk. Comparative experiments were also carried out with L. acidophilus.

In vitro experiments showed that human milk when only slightly heated for sterilization, meets the cystine requirement of L. bifidus. Autoclaved human milk is distinctly less effective in replacing cystine in a cystine-free medium. Slightly heated cow's milk is equal to autoclaved human milk, while autoclaved cow's milk shows a very weak effect, if any.

All the L. bifidus strains studied were found to require strepogenin as an essential growth factor. Human milk and cow's milk were equally potent sources of this factor. Strong heating had no effect on the strepogenin activity of the milks. The activity persisted in the whey after the removal of casein, lactalbumin, and lactoglobulin by rennin, acid and heat treatments.

No fatty acids tested had a growth-promoting effect on L. bifidus in the presence of acetate. On the contrary, this organism was inhibited by both saturated and unsaturated fatty acids, capric, lauric, and linoleic acid having the strongest effect.

L. acidophilus did not require strepogenin as a growth factor. Unsaturated fatty acids, however, were found to be essential for maximal growth. Some saturated fatty acids,

lauric and capric in particular, had a strongly inhibiting effect on this organism.

The growth-inhibiting effect of fatty acids on L. bifidus as well as on L. acidophilus was overcome by human milk and, to a lesser degree, by cow's milk. Tween 80 and gum arabic, also, were able slightly to reverse the inhibiting effect of the fatty acids.

TETRAZOLIUM REDUCTION TEST FOR QUALITY CONTROL OF MILK

H. Laxminarayana and K. K. Iya of the Indian Dairy Research Institute, Bangalore, India, in the course of their investigations on the reducing activities of lactic-acid bacteria and other dairy organisms in milk found 2,3,5 triphenyl tetrazolium bromide to be a useful oxidation-reduction indicator for determining the bacteriological quality of milk. Tetrazolium does not impart color initially to milk. When the dye undergoes reduction by bacterial activity, it is converted into a red compound "triphenyl formazan" and the milk assumes a red color which gradually increases in intensity. The time taken for the development of the red color in milk was found to bear a close relation to the bacterial content of milk and also to reflect its keeping quality. The red color shades could be differentiated visually and compared against a set of standards (T_0-T_6), prepared by adding varying concentrations of safranin and methyl orange to skim milk.

The procedure for testing milk consists in adding 1 ml. of a 0.1 per cent

aqueous solution of tetrazolium to 10 ml. of milk in 6" x 5/8" Pyrex test tubes and incubating the tubes at 37°C in a water bath, as in the case of methylene blue reduction test. The time taken to reach the first distinct red color shade T-1 (corresponding to 10 per cent reduction of the indicator) could be used as the basis for classifying market milk samples into three grades, viz., good (more than 4 hours), fair (2 to 4 hours) and poor (less than 2 hours). Analysis of a large number of market milk samples showed that there was a good correlation between tetrazolium reduction time to stage T-1, and methylene blue reduction time, or one hour resazurin reduction test. In the case of poor quality milk samples (containing more than 10 million cells per ml.) the tetrazolium and methylene blue reduction times were almost identical.

Tetrazolium testing appears to offer some advantages over other tests for adoption in quality control work. Poor quality milk supplies can be readily detected; the development of red color due to reduction of tetrazolium is easy to follow visually; and the reduction of the dye is not reversible and as such the test is not affected by exposure of milk to atmospheric oxygen. In addition, tetrazolium unlike methylene blue or resazurin, is not influenced by reducing systems formed in pasteurized or sterilized milks and thus offers a suitable means of testing the bacteriological quality of heat-treated milks.

THE BACTERIOLOGY OF WHALEMEAT

M. Ingram and J. G. Sharp of the Low Temperature Research Station, Cambridge, claim as a result of their studies that as soon as a whale has been killed in the usual way, the flesh throughout contains about 50 cells/gm of Cl. welchii type A, Cl. bifermentans, and peculiar Enterococci. Precisely similar organisms, and virtually no others, were found in the gut of the whale, and in the blood, suggesting that they can pass into the blood-stream in the agony of death even if the gut is undamaged. The body temperature stays at 37-35°C for days, but the development of the bacteria in the muscles does not begin till rigor mortis has occurred. For reasons incompletely known, the time between death and rigor varies greatly in whales, from less than one hour up to 15 hours or occasionally more. It is not yet clear whether there is a similar inhibition of bacterial growth before rigor in other mammals.

INTERNATIONAL STANDARD MUSICAL TUNING FREQUENCY

Technical Committee 43 (Acoustics) of the International Standards Organization (ISO) met in London on 20 - 21 October, and delegates from 32 member countries agreed on a standard musical pitch as well as to tolerances for the manufacture of musical instruments. The following recommendations were made:

(i) The "standard tuning frequency" is the frequency for the note A in the treble stave, and shall be 440 cycles per second.

(ii) This frequency shall be observed as closely as possible when tuning musical instruments.

(iii) Tuning and re-tuning shall be effected with the aid of instruments producing the standard tuning frequency within an accuracy of ± 0.5 c/s or enabling the frequency of musical sounds to be measured to the same relative accuracy.

(iv) Musical instruments shall be so constructed that, under the temperature and other working conditions specified by the manufacturer, they are capable of being tuned in accordance with the standard frequency of 440 c/s. (To this end instrument manufacturers may find it desirable to use tuning devices having an accuracy equal to or better than ± 0.25 c/s.)

FORTHCOMING EVENTS

The Third General Assembly and International Congress of the International Union of Crystallography will take place in Paris on 21 - 28 July 1954. The program includes 15 sessions devoted to various aspects of crystallography, including those on apparatus and techniques, structures of metals and alloys, of organic and inorganic substances, order - disorder transformations, etc. In addition, two special symposia are being organized for the days immediately following the general discussion.

These will be devoted to the localization of hydrogen atoms and the hydrogen bond, and to the mechanism of phase changes in crystals. Further information concerning attendance, etc., is available from Mons. A. J. Rose, Laboratoire de Mineralogie, 1 rue Victor Cousin, Paris 5e, France, and from Professor J.D.H. Donnay of Johns Hopkins University.

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